

Directed Energy directorate: more than just lasers

by Rich Garcia, Directed Energy directorate

KIRTLAND AIR FORCE BASE, N.M. – Perhaps it's too simple to say that they take exotic gadgets, like lasers, and turn them into something that could ruin the other guy's day. But, to some extent, that's what the more than 600 men and women who work at the Air Force Research Laboratory's Directed Energy directorate do.

Creating more than just lasers, these scientists and engineers work on plasma projectiles, "air cannons," high-energy microwave technologies, large space-based optics, and sophisticated laser-based sensors on massive telescopes, aboard aircraft and spacecraft.

"We've been working on directed energy technologies for more than 20 years," said Dr. Earl Good, who heads the \$135 million-a-year directorate. "Our research is now starting to gain widespread understanding and acceptance, with war-fighters beginning to grasp what these technologies can do on the battlefield."

Reflecting some of this interest are two major directorate studies chaired by senior Air Force leadership: Former Air Force Chief of Staff Gen. Ronald R. Fogleman, now retired, headed a study that examined how directed energies could be applied in tactical airborne combat. Retired Air Force Gen. John L. Piotrowski took charge of another study aimed at evaluating how laser and optical systems might be used in future space systems. For both of these studies, the directorate worked closely with potential users in Space Command, Air Force Special Operations Command, the Army and the Navy.

The near-term value of directed energy weapons is best illustrated in the Airborne Laser, a project that grew out of the directorate and is now looked at as the Air Force's No. 1 technology program. Within 10 years, the Air Force intends to have a seven-aircraft fleet of laser-carrying jumbo jets. Carrying a chemical laser invented by directorate scientists, the Airborne Laser will be able to destroy attacking Scud-like missiles from hundreds of miles away.

The directorate continues to work on Airborne Laser follow-on programs. These include an all-gaseous chemical laser and an inexpensive liquid crystal-based technology that can correct for atmospheric distortions which would otherwise limit the effectiveness of the laser. A new laser site was recently opened at White Sands (N.M.) Missile Range to evaluate and improve the effectiveness of the Airborne Laser.

Other directorate researchers operate the two largest telescopes



I WISH I MAY, I WISH I MIGHT - A laser streaking spaceward from the Directed Energy directorate's Starfire Optical Range senses atmospheric distortions. This AFRL directorate pioneered technologies for using a laser and deformable optics to sense and correct for these distortions so that objects in space can be seen more clearly.



IT'S A BIRD, IT'S A PLANE...NO IT'S - A specially modified flying laboratory called Argus (for the mythological creature of 100 eyes) gathers information using 11 different sensor platforms. Argus supports many of the Directed Energy directorate's research programs.



FIRE IN THE SKY - An artist's concept depicts the Airborne Laser, the Air Force's No. 1 technology program. This system that uses an aircraft-mounted laser to destroy Scud-like missiles hundreds of miles away. The Directed Energy directorate invented the laser that is being used on the aircraft as well as the technologies for correcting for range, limiting distortions in the atmosphere. The directorate continues to work closely with the Airborne Laser System Program office on the project.

in the Department of Defense. Although not astronomers, they use these telescopes to develop ways to “see” things in space more clearly. This is a critical need for those who try to figure out what different satellites are doing.

Other directorate scientists are creating plasmas – the super-hot, gaseous atmosphere of stars – to see how plasmas might be used as defensive systems in the distant future. Another exotic energy form being examined involves high-energy microwaves that could disrupt electronics. While computers make weapons smart, high-power microwaves can make weapons dumb again.

As the Air Force moves closer to being a space force, directorate researchers are applying their skills and experience in directed energy to space-related systems.

For example, placing large optics in space is vital to the movement of laser energy from the ground to space and from one area of space to another. Work in this area is not being done in a vacuum (no pun intended). Aside from working closely with NASA, directorate scientists are involving three of the laboratory's other directorates. At Wright-Patterson AFB, Ohio, mirror coatings are being developed by the Materials and Manufacturing directorate and sensors by the Sensors directorate. Also being developed are large, lightweight structures by the Space Vehicles directorate, a sister directorate here. Funding for the basic research that is needed to grow these technologies is provided by the laboratory's Office of Scientific Research in the Washington D.C. area. It truly is an integrated AFRL approach.

Putting a large mirror in space, using this country's current rocket boosters, is a Herculean challenge. An inventive alternative seeks to use a thin film of plastic that can be rolled up in the launch vehicle and popped out in space to make a large mirror. A high-quality, “solid” surface can be made by using a series of techniques to correct for any imperfections in the mirror surface.

In looking for other ways to use lasers, directorate technologists have developed a means to fire two laser beams into man-made clouds (chemical weapons or discharges from manufacturing plants) and compare the two beams to identify what chemicals are present. A variation of this technology was used overseas to build a laser “fence” that would provide warning to our troops of a hazardous-agent attack. Lasers can



HANGING OUT - An F-16 fighter is suspended in a large anechoic chamber where it can be evaluated against the effects of high-energy microwaves. The Directed Energy directorate is conducting research on microwaves and their effects on Air Force systems.

also be used to look through camouflage. Because light reflects differently from various materials, short-pulsed lasers could be used to penetrate through the camouflage to tell us what is beneath.

“Lasers work at the speed of light and are not constrained by gravity,” Good said. “They can be very focused – precise in their application – providing the war-fighter with a graduated means of delivering energy. In this age of concerns over collateral damage, directed energy weapons have the ability to be very precise – surgical.”

The Directed Energy directorate handles about 95 percent of DOD’s money in directed energy. Based on results coming from the directorate’s military, civilian employees and contractors, this trend is expected to continue as directed energies become the future of the Air Force. @

For more information about the Directed Energy directorate and any of its programs, visit their web site at <http://www.de.af.mil>.